FEDERAL GOVERNMENT

Executive Branch Judicial Branch Legislative Branch

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Legacy of Western Exploration

1804-06	Lewis and Clark	Northwest Passage
1805-07	Lt. Zebulon Pike	Rocky Mountains/Pikes Peak
1807	Survey of the Coast	Geodesy, topo-, hydrography
1819-20	Maj. Stephen Long	Rocky Mountains
1834-35	G. Featherstonhaugh	Ozarks Mountains
1839-40	David Owen	Upper Miss. Valley
1840s-50s	Corps of Topo. Eng.	Routes to Pacific
1867-79	Four Surveys	King, Hayden, Powell, Wheeler -- rivalry, overlap
1879	U.S. Geological Survey	Established by Congress

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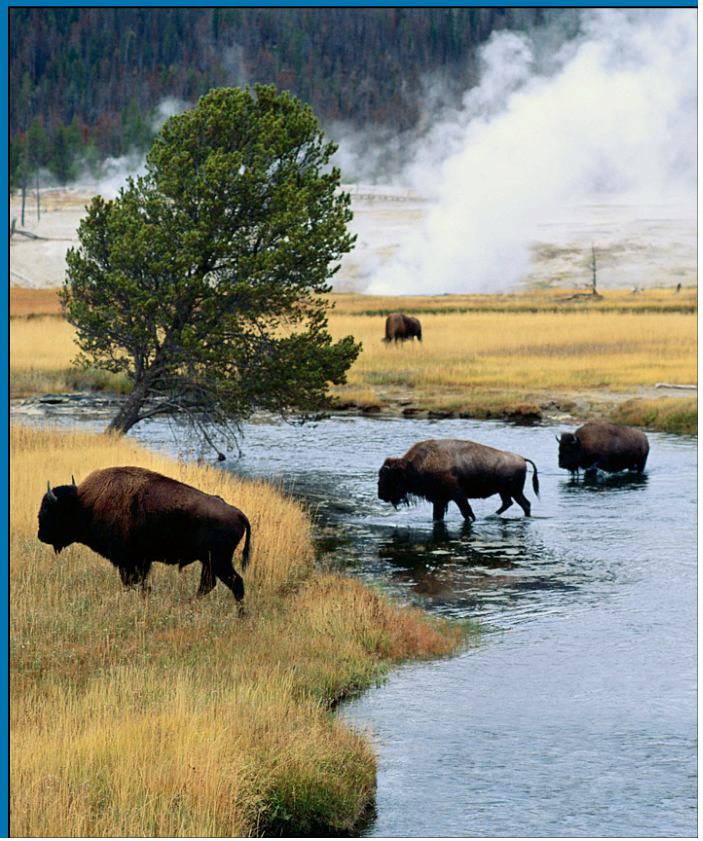
Establishment of U.S. Geological Survey

- March 3, 1879, President Rutherford Hayes
- Responsible for *"classification of the public lands, and examination of the geologic structure, mineral resources, and products of the national domain."*
- King Survey already complete; Hayden, Powell, Wheeler surveys discontinued.



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What is the U.S. Geological Survey?

- The science bureau of the Dept. of the Interior
- Unique combination of earth, life, and physical sciences
- Established in 1879 based on four previous western surveys in the tradition of Lewis & Clark
- Today, conducts surveys, investigations, and research

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U.S. DEPARTMENT OF THE INTERIOR
MARCH 3, 1849

USGS Mission

- Serve the Nation by providing reliable scientific information to:
  - Describe and understand the Earth;
  - Minimize loss of life and property from natural disasters;
  - Manage water, biological, energy, and mineral resources; and
  - Enhance and protect our quality of life.

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Science at USGS - Today

- An independent fact-finding agency; no basis for advocacy
- No regulatory or policy functions
- No natural resource or land management responsibilities
- USGS supports all DOI bureaus with science information
- Science resources leveraged in partnership with more than 2,000 agencies:
  - . State, local, tribal governments
  - . Academic community
  - . Other Federal allies
  - . Non-governmental organizations

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Our Organization Follows Our Science Strategy

Ecosystems

Energy and Minerals, and Environmental Health

Natural Hazards

Water

Climate and Land-Use Change

Core Science Systems

USGS

PRELIMINARY
SUBJECT TO REVISION

Water

- Groundwater Resources
- National Water Quality Assessment
- Hydrologic Research and Development
- Streamgage Networks
- Cooperative Water Program

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Santa Rosa Plain Project Overview

Tracy Nishikawa, Linda Woolfenden, Joe Hevesi, and Loren Metzger

U.S. Department of the Interior
U.S. Geological Survey

Objectives of Santa Rosa Plain Project

- Develop an updated assessment of the geohydrology and geochemistry of the SRP.
- Develop a groundwater-flow model for SRP.
- Evaluate the hydrologic impacts of alternative groundwater management strategies on the basin.

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USGS Personnel

- Database/GIS
  - Kathryn Koczot
  - Andy Morita
  - Donna Knifong
- Data Collection/ Interpretation
  - Loren Metzger
  - Chris Farrar
- Geologic Modeling
  - Victoria Langenheim
  - Robert McLaughlin
  - Robert Jachens
- Lithologic Modeling
  - Don Sweetkind
  - Emily Taylor
- Modeling
  - Joe Hevesi
  - Linda Woolfenden
  - Diane Rewis
  - Tracy Nishikawa
  - Eric Reichard
  - Rich Niswonger

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Cooperators

- Sonoma County Water Agency
- Stakeholders
  - Cal-American Water
  - City of Cotati
  - City of Rohnert Park
  - City of Santa Rosa
  - City of Sebastopol
  - Town of Windsor

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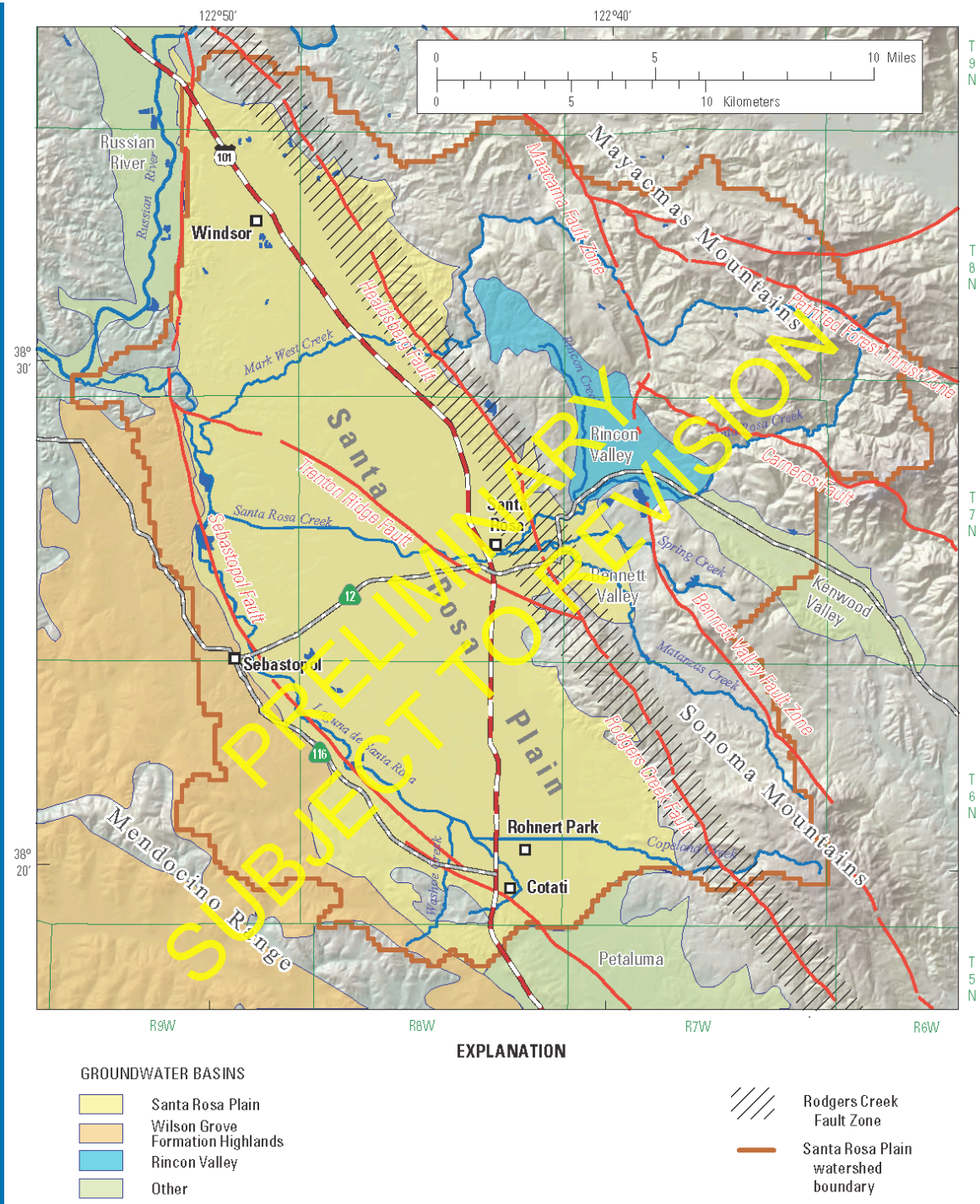
122°50′
122°40′
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T 8 N
T 7 N
T 6 N
T 5 N
38° 30′
38° 20′
R9W
R8W
R7W
R6W
Russian River
Windsor
Mayacmas Mountains
Mayacma Fault Zone
Healdsburg Fault
Mark West Creek
Santa Rosa Plain
Trenton Ridge Fault
Santa Rosa Creek
Sebastopol Fault
Sebastopol
Laguna de Santa Rosa
Rincon Valley
Rincon Creek
Petrified Forest Thrust Zone
Carneros Fault
Spring Creek
Bennett Valley
Kenwood Valley
Matanzas Creek
Bennett Valley Fault Zone
Rodgers Creek Fault Zone
Sonoma Mountains
Rohnert Park
Copeland Creek
Cotati
Petaluma
Mendocino Range
Wasp Creek
PRELIMINARY
SUBJECT TO REVISION
EXPLANATION
GROUNDWATER BASINS
Santa Rosa Plain
Wilson Grove Formation Highlands
Rincon Valley
Other
Rodgers Creek Fault Zone
Santa Rosa Plain watershed boundary

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Four Project Tasks

- Compile existing data
- New data collection (water quality, geologic and geophysical)
- Data interpretation
- Groundwater-flow model

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Data Compilation

- Base maps in place
- Completed data inventory
- Compiled pumping data
- Completed land-use data (1959, 1974, 1979, 1986, 1999, 2007)
- Compiled water-level data
- Compiled water-quality data from DWR, stakeholders, GAMA, and DPH.
- Compiled DWR well-construction data

USGS

Data Interpretation

- Precipitation
- Basin-wide water levels
- Plotted hydrographs
  - Trends
  - Vertical head differences
- Streamflow records
- Interpreted water-quality data
- Hydrogeologic data

USGS

Water-Quality Tasks

- Compiled historic data through 2009
  - 5,000 records
  - 410 wells
  - 20 surface-water sites
- Highlight constituents of concern
- Collected new data
  - Depth-dependent temperature data from Spring Lake well
  - Depth-dependent WQ from Sebastopol well

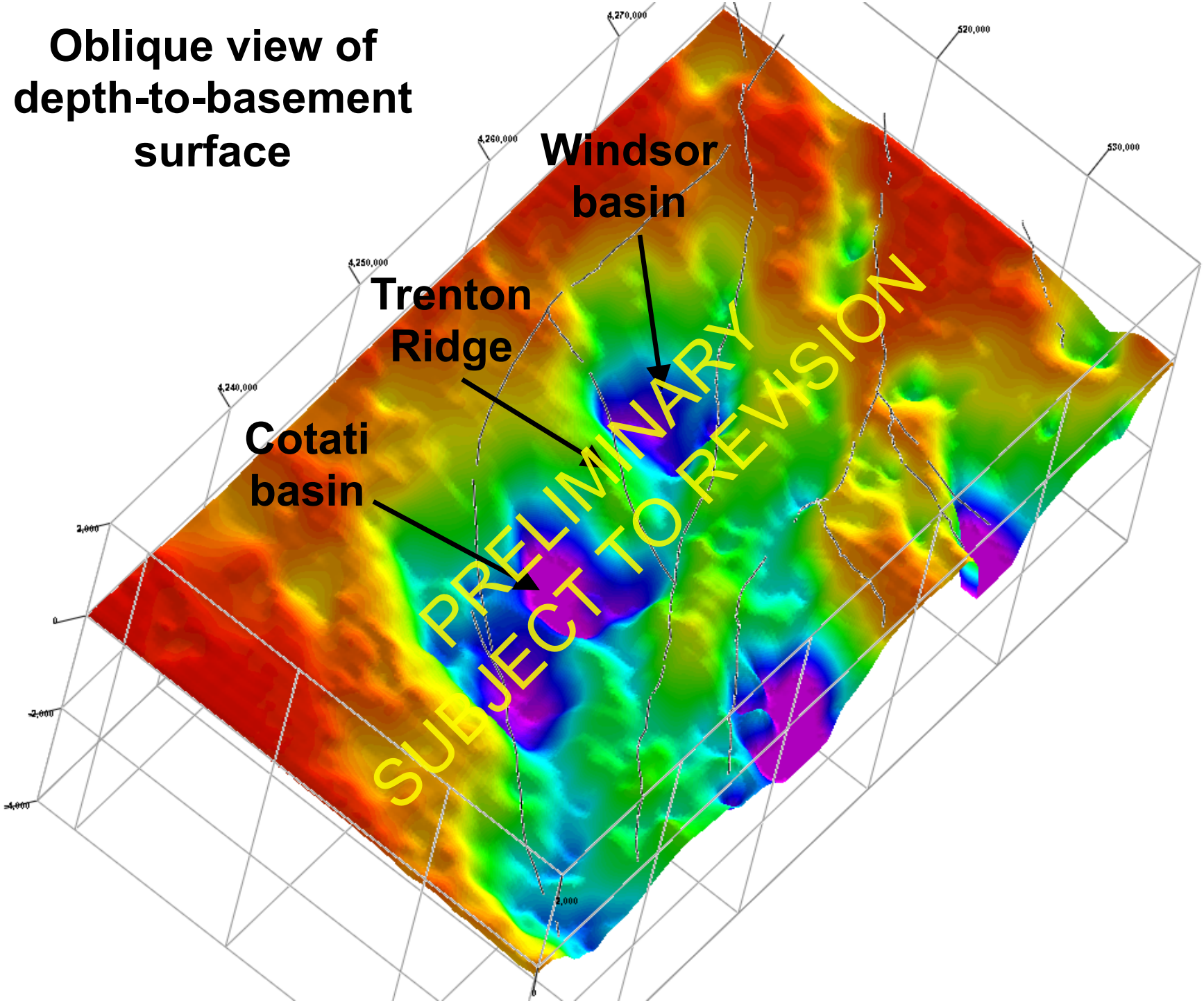
USGS

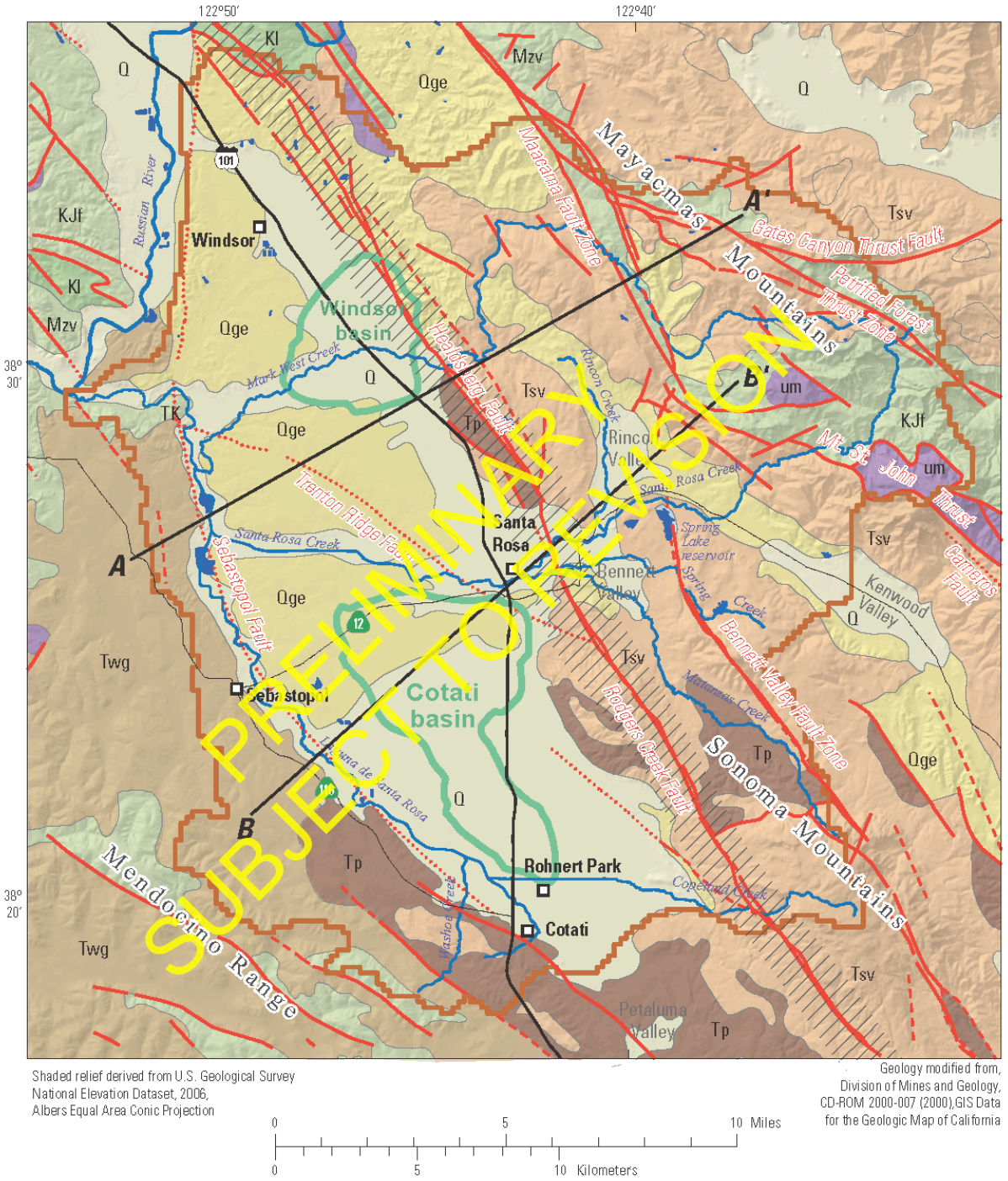
Geohydrologic Characterization

- Published 5 reports/papers
- Compiled lithology and stratigraphy for all geology wells in Access database
- Collected lithologic samples and seismic velocity logs from 2 Santa Rosa wells
- Estimated depth-to-basement using gravity
- Developed 3-D geologic model suitable for use in flow model
- Constructed 3-D lithology model, currently using to zone HGU's by rock property
- Seismic survey

USGS

Oblique view of depth-to-basement surface




122°50′
122°40′
38° 30′
38° 20′
PRELIMINARY
SUBJECT TO REVISION
Windsor
Santa Rosa
Sebastopol
Rohnert Park
Cotati
Windsor basin
Cotati basin
Mayacmas Mountains
Sonoma Mountains
Mendocino Range
Petaluma Valley
Bennett Valley
Kenwood Valley
Rincon Valley
Maacama Fault Zone
Healdsburg Fault
Trenton Ridge Fault
Sebastopol Fault
Rodgers Creek Fault
Bennett Valley Fault Zone
Gates Canyon Thrust Fault
Petrified Forest Thrust Zone
Mt. St. John Thrust
Carneros Fault
Russian River
Mark West Creek
Santa Rosa Creek
Spring Creek
Matanzas Creek
Copeland Creek
Laguna de Santa Rosa
Spring Lake reservoir
Q
Qge
Mzv
KJf
Kl
TK
Tsv
Tp
Twg
um
A
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B
B′
101
12
Shaded relief derived from U.S. Geological Survey
National Elevation Dataset, 2006,
Albers Equal Area Conic Projection
Geology modified from,
Division of Mines and Geology,
CD-ROM 2000-007 (2000),GIS Data
for the Geologic Map of California
0 5 10 Miles
0 5 10 Kilometers

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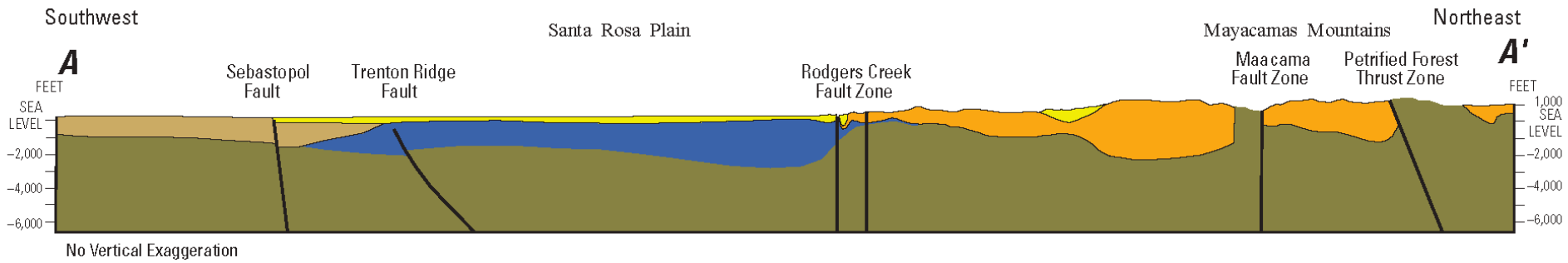

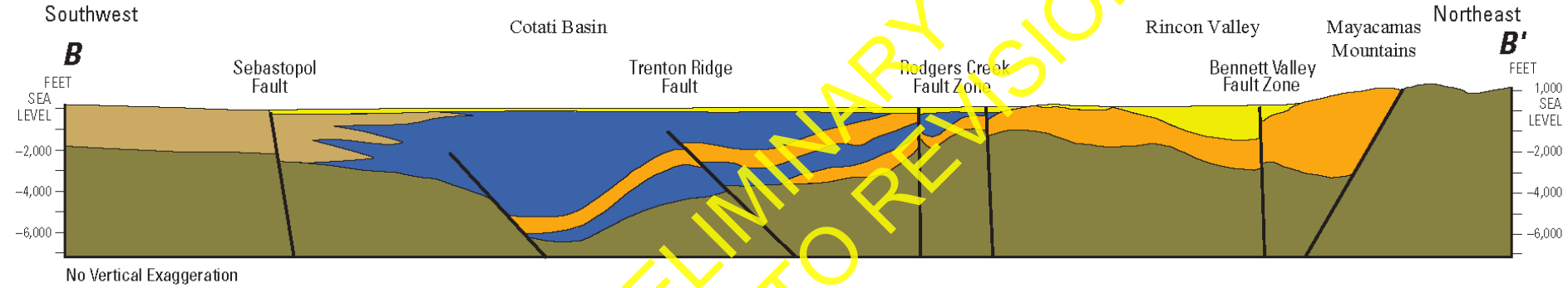

EXPLANATION

- Glen Ellen Formation
- Wilson Grove Formation
- Sonoma Volcanics
- Petaluma Formation
- Undifferentiated basement

Fault, sense of offset not shown

Geology modified from Mc:Laughlin and others (2008) and Sweetkind and others (2010)

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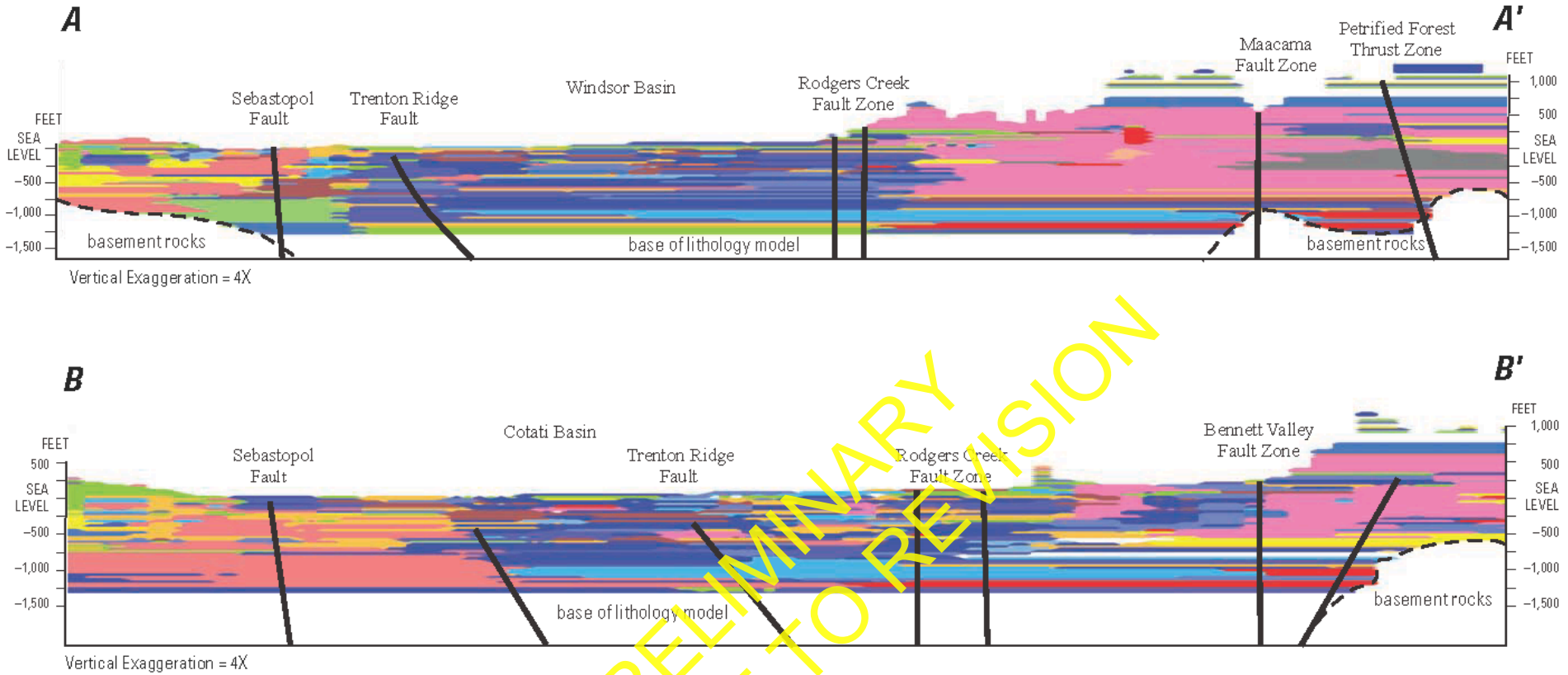

EXPLANATION

- Gravel
- Sand and gravel
- Sandstone and gravel
- Sand
- Sandstone
- Sand and clay
- Sandstone and clay
- Clay, sand, and gravel
- Clay, sand, and trace gravel
- Clay and gravel
- Clay and trace gravel
- Clay and sand
- Clay and sandstone
- Clay
- Conglomerate
- Volcanic conglomerate
- Basalt
- Ash and (or) tuff
- Undifferentiated basement
- No data

Fault, sense of offset not shown

Faults were not used in construction of lithology model and are shown for illustrative purposes only.

Lithologic model from Sweetkind and others (2010)

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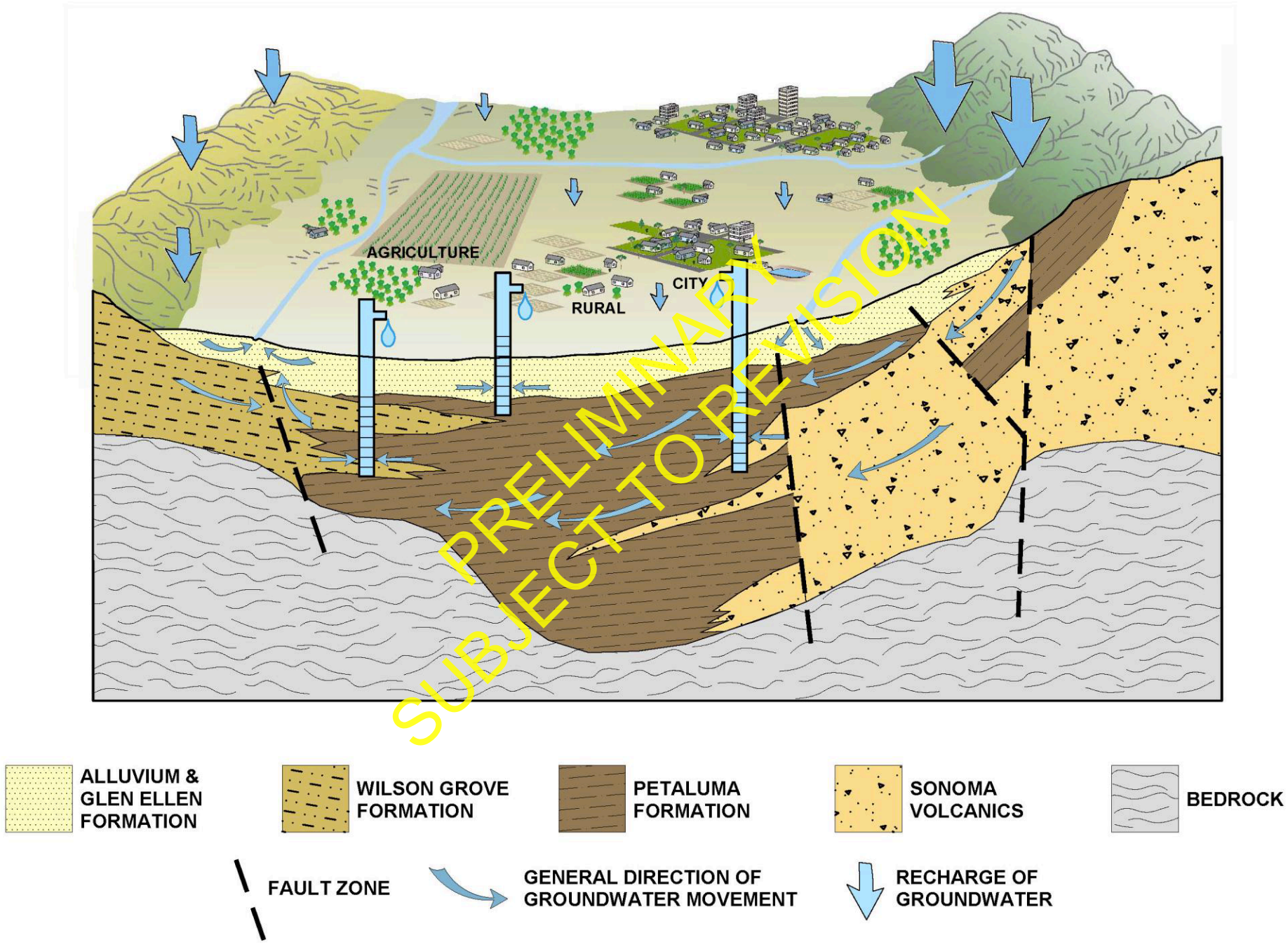
AGRICULTURE
CITY
RURAL
PRELIMINARY
SUBJECT TO REVISION
ALLUVIUM &
GLEN ELLEN
FORMATION
WILSON GROVE
FORMATION
PETALUMA
FORMATION
SONOMA
VOLCANICS
BEDROCK
FAULT ZONE
GENERAL DIRECTION OF
GROUNDWATER MOVEMENT
RECHARGE OF
GROUNDWATER

GSFLOW—Coupled Ground-Water and Surface-Water Flow Model Based on the Integration of the Precipitation-Runoff Modeling System (PRMS) and the Modular Ground-Water Flow Model (MODFLOW-2005)

By Steven L. Markstrom, Richard G. Niswonger, R. Steven Regan, David E. Prudic, and Paul M. Barlow

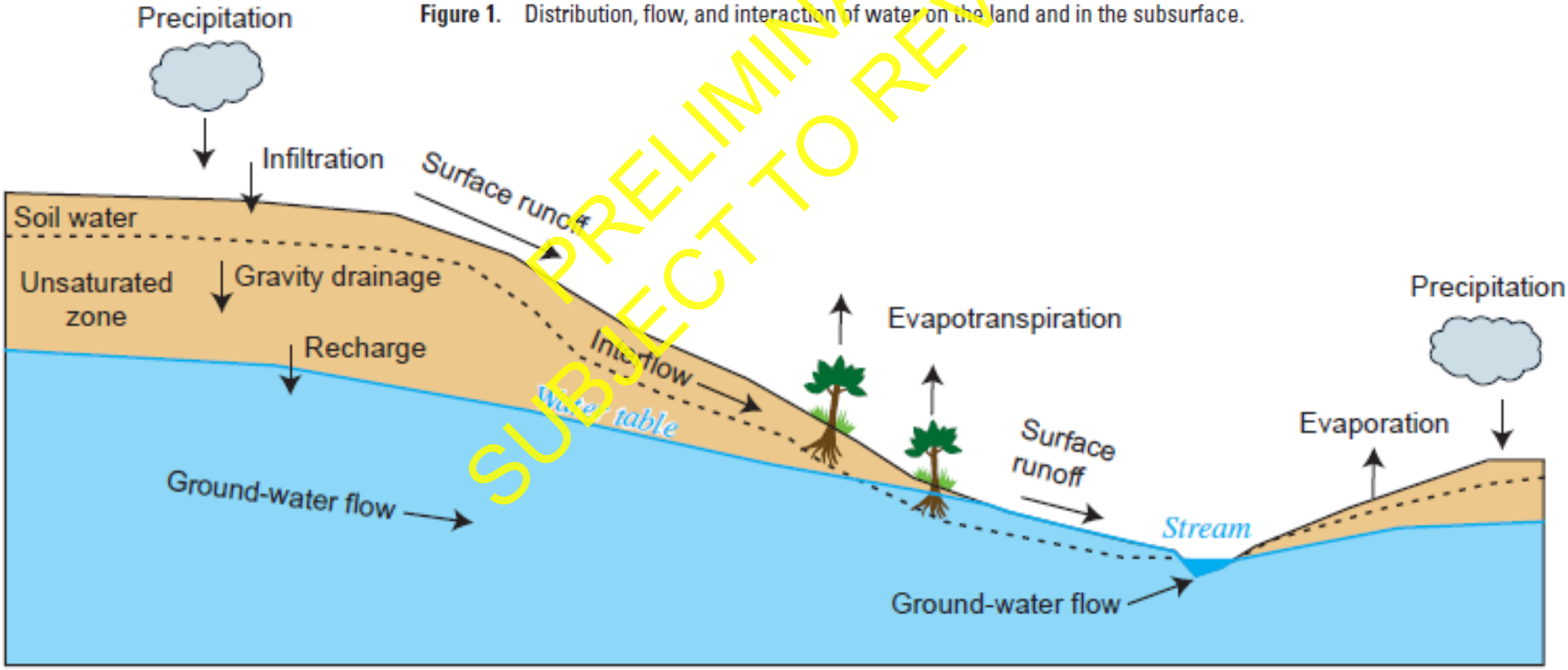

Figure 1. Distribution, flow, and interaction of water on the land and in the subsurface.

Why GSFLOW? 2 Words: "Natural Recharge"

- Estimate based on precipitation record or surrogate
- Simulate recharge using a watershed model and use as input for groundwater-flow model
- Coupled approach, e.g., GSFLOW

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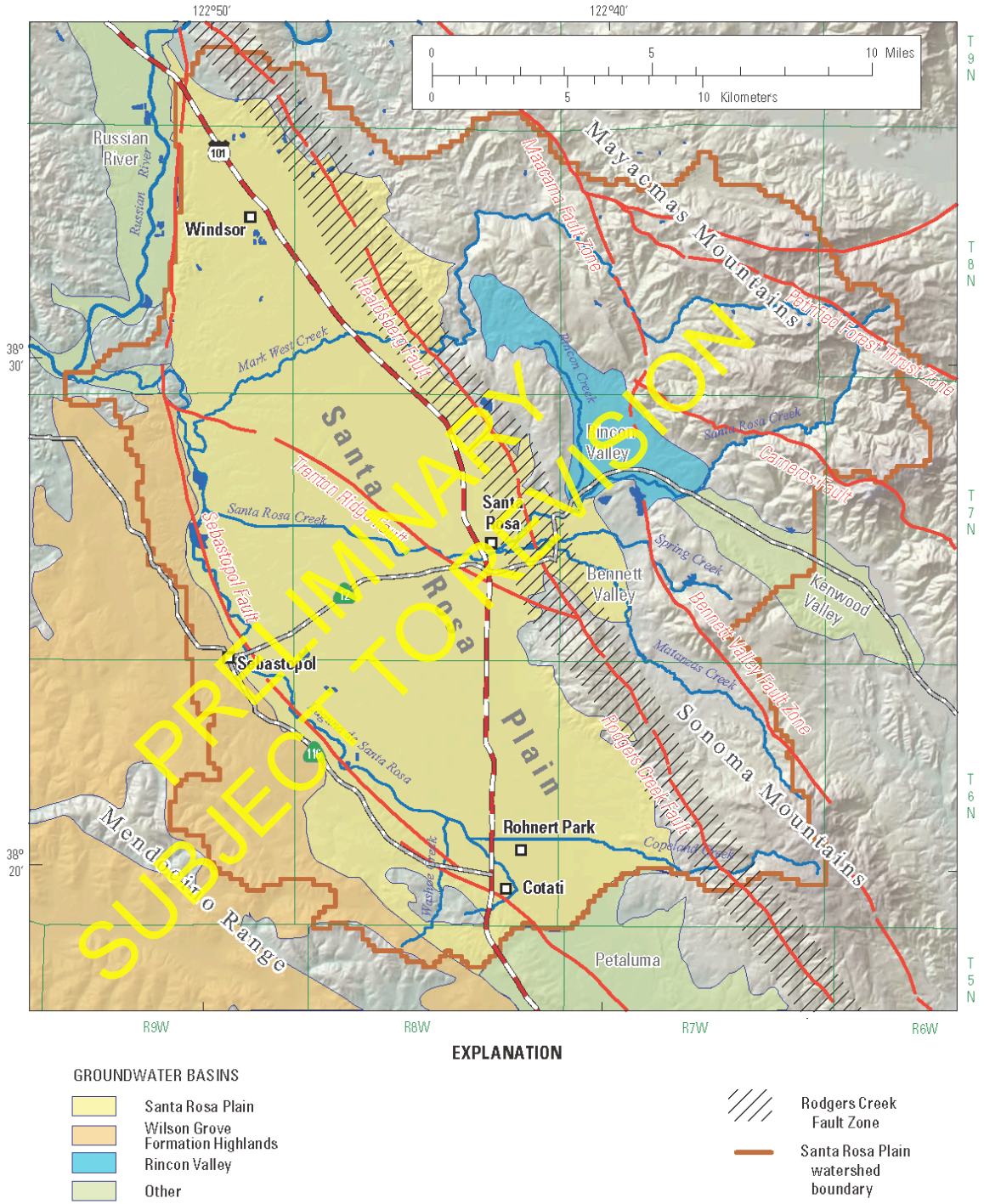
Model Area= Domain



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Modeling Phases

- PRMS
  - Develop climate database and model
  - Define physical characteristics of basin
  - Develop and calibrate PRMS model
- MODFLOW-2005
  - Define initial recharge boundary condition for groundwater-flow model
  - Develop and calibrate groundwater-flow model
- GSFLOW (1975-2010)
  - Develop coupled watershed – groundwater model
  - Calibrate coupled model to both streamflow and water-level data

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GSFLOW Model Development:

- GSFLOW datasets completed
- GSFLOW calibration completed
- Simulated 1975-2010 (daily SW & monthly GW)
  - Simulated water budget
  - Estimated unreported agricultural pumpage

USGS

Groundwater-Flow Component

- Defined model domain
- Generated model grid
- Imported 3-D geologic data into model
- Built datasets
- Calibrated transient GSFLOW model

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Groundwater-Flow Component

- Inputs include boundary conditions, aquifer properties, streams, flow barriers, and pumpage
- The steady-state year is 1974; the transient simulation period is 1975-2010
- Monthly stress periods

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GSFLOW Applications

- Test “what if” scenarios
  - Artificial recharge
  - Pumping
  - ASR
- Climate change
- Land-use change

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Questions?

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